(No Model.) 4 Sheets—Sheet 1.

E. NORTON.

AUTOMATIC SHEET METAL ROLLING MILL.

No. 600,165. Patented Mar. 8, 1898.

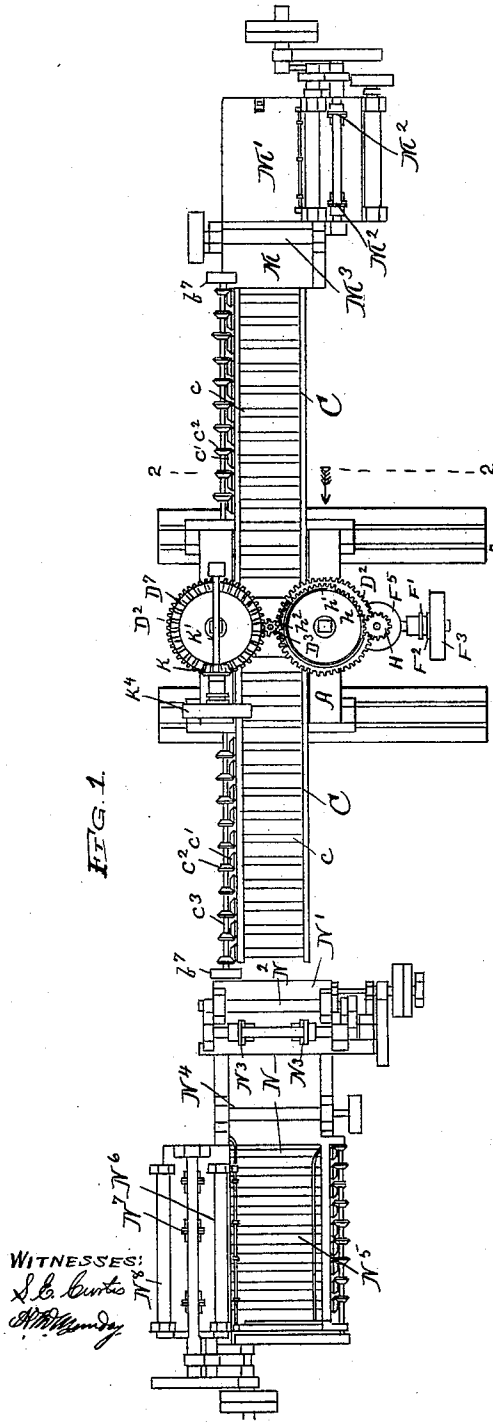

FIG. 1.

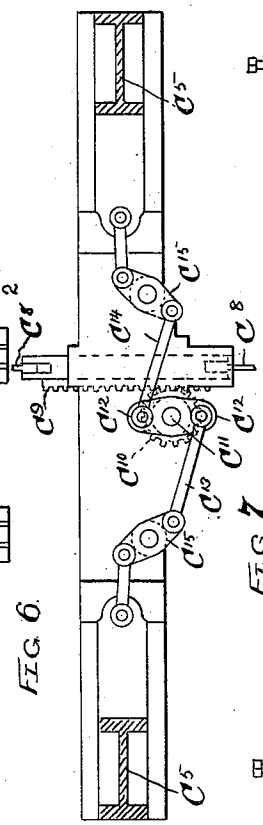

FIG. 6.

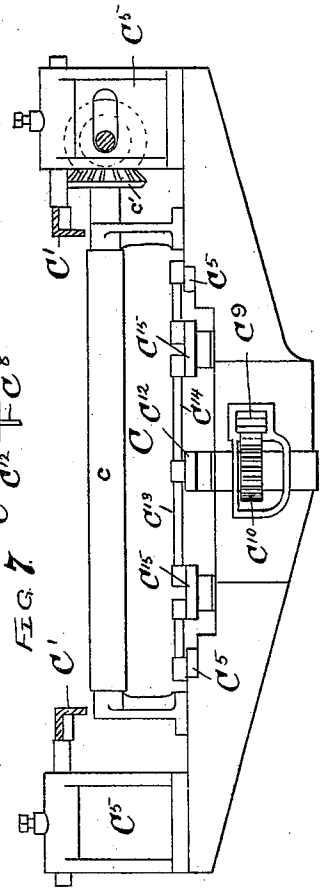

FIG. 7.

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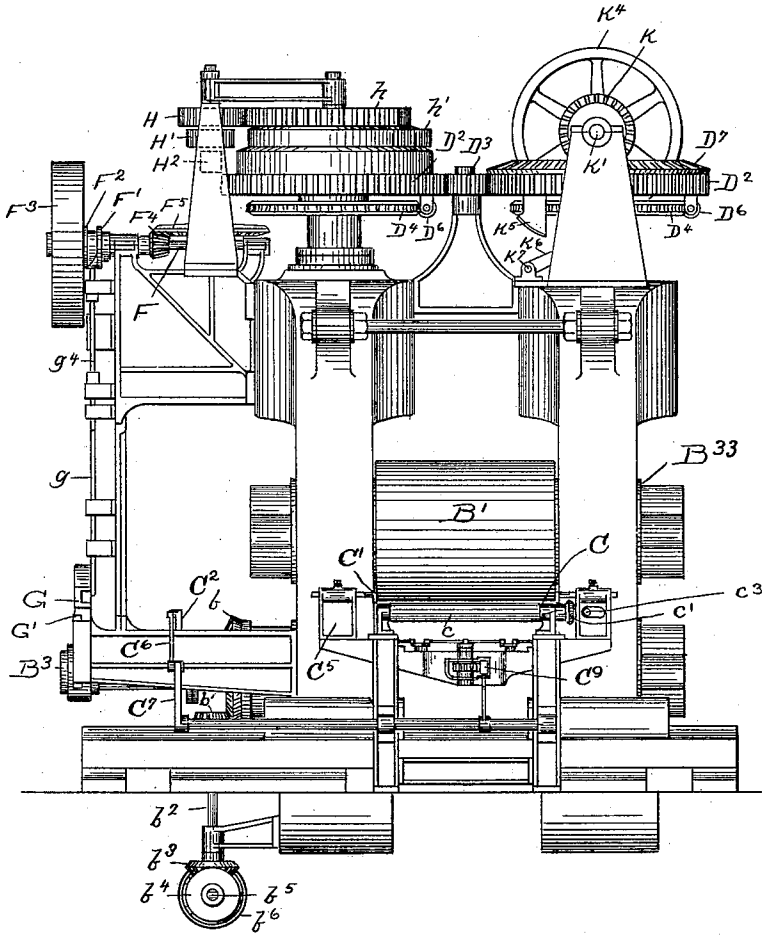
(No Model.) 4 Sheets—Sheet 2.

E. NORTON.

AUTOMATIC SHEET METAL ROLLING MILL.

No. 600,165. Patented Mar. 8, 1898.

FIG. 2.



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(No Model.) 4 Sheets—Sheet 3.

E. NORTON.

AUTOMATIC SHEET METAL ROLLING MILL.

No. 600,165. Patented Mar. 8, 1898.

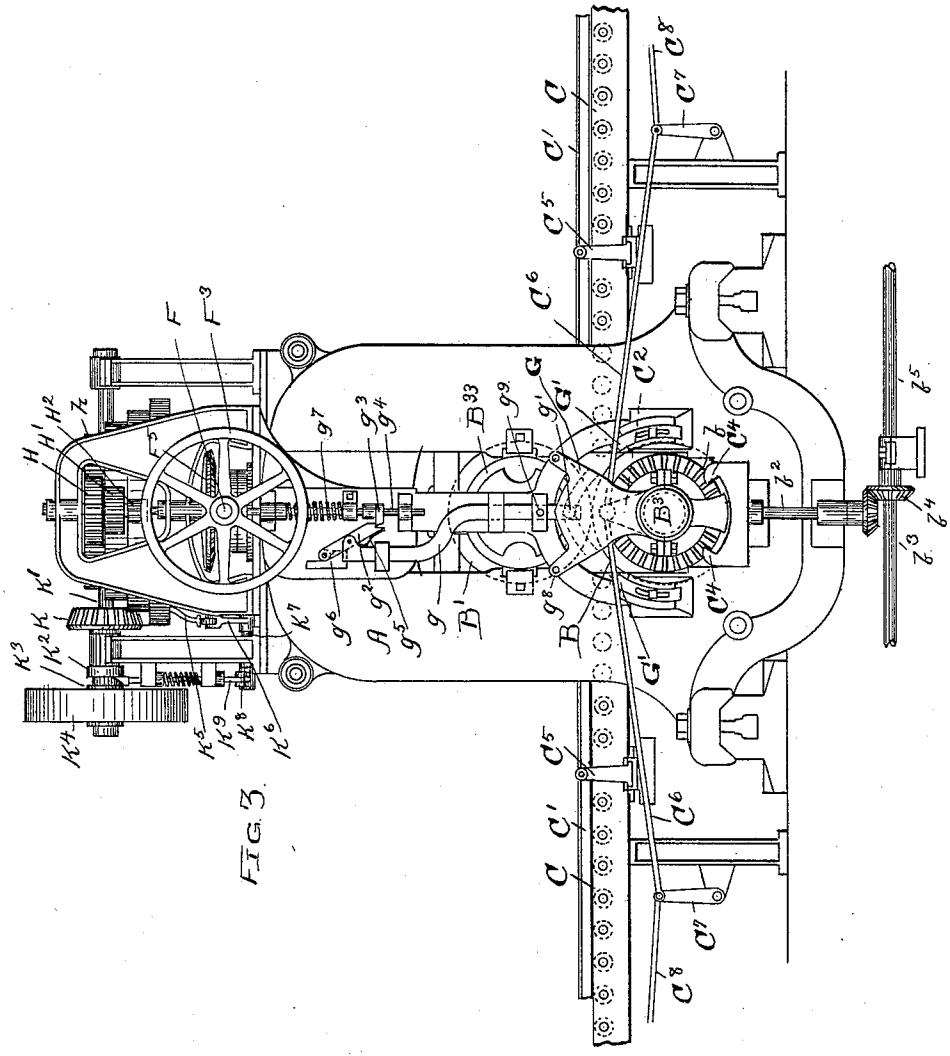

FIG. 3.

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(No Model.) 4 Sheets—Sheet 4.

E. NORTON.

AUTOMATIC SHEET METAL ROLLING MILL.

No. 600,165. Patented Mar. 8, 1898.

FIG. 4.

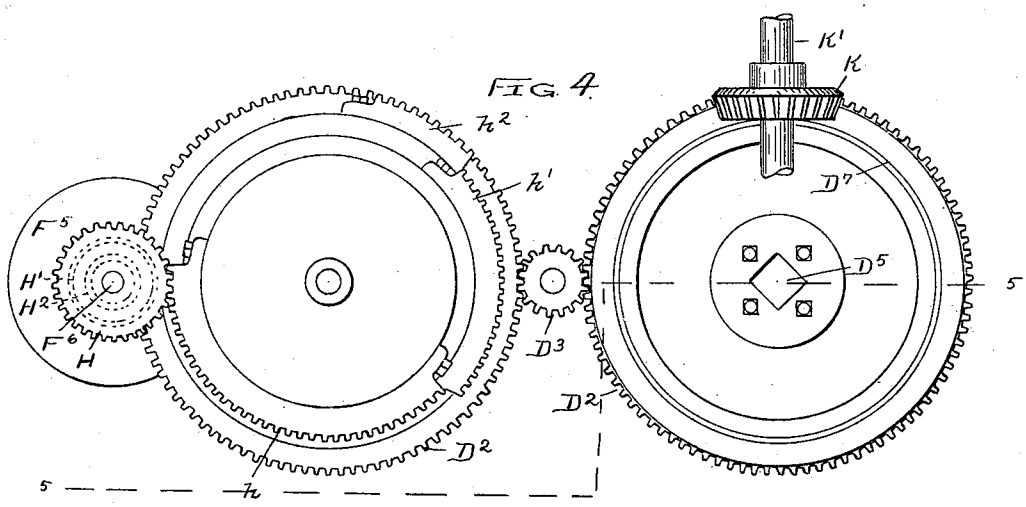
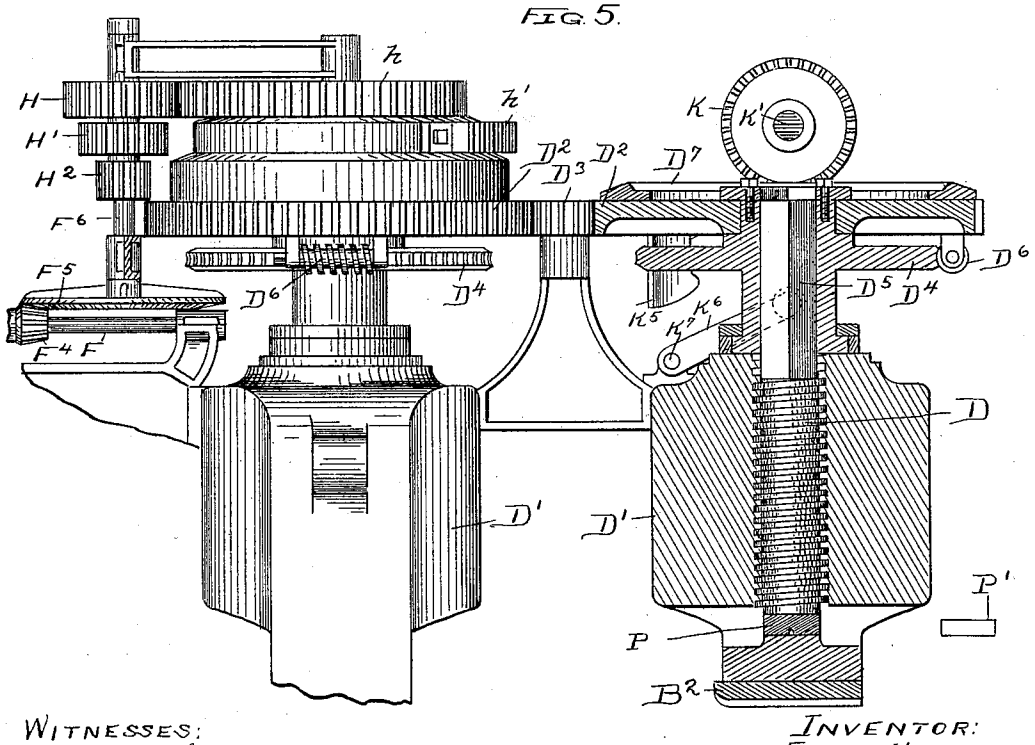


FIG. 5.



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UNITED STATES PATENT OFFICE.

EDWIN NORTON, OF MAYWOOD, ILLINOIS, ASSIGNOR TO THE NORTON BROS., OF CHICAGO, ILLINOIS.

AUTOMATIC SHEET-METAL-ROLLING MILL.

SPECIFICATION forming part of Letters Patent No. 600,165, dated March 8, 1898.

Application filed July 22, 1897. Serial No. 645,490. (No model.)

To all whom it may concern:

Be it known that I, EDWIN NORTON, a citizen of the United States, residing in Maywood, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Automatic Sheet-Metal-Rolling Mills, of which the following is a specification.

My invention relates to sheet-metal-rolling mills.

In sheet-metal-rolling mills heretofore in use in this and other countries for reducing bars of iron or steel into thin sheets—such as are rolled in packs to comparatively thin gages and used for tin-plate, black plate, and sheet-iron—it has always been customary to employ a number of skilled operators commonly known as the "roller-man," who has general charge of the mill and who feeds the heated bars or packs to the rolls; the "catcher," who catches the bars or packs as they emerge from the rolls with iron tongs and returns them over the top of the rolls to the roller-man ready for the next pass, and the "screw-man," who operates or turns the feed or adjusting screws, by which the rolls are set closer together after each pass, the operation being repeated again and again until the packs are the desired thickness. From time to time the bars or packs are returned to the furnace and reheated.

The object of my invention is to provide an automatic sheet-metal-rolling mill for performing the operations heretofore done by hand by the several skilled workmen above mentioned.

My invention consists in an automatic sheet-metal-rolling mill comprising rolls to reduce the metal to the desired thickness; feed-tables to feed the series of bars, sheets, or packs to the rolls and to receive the same from the rolls; feed or adjusting screws to set the rolls closer and closer together as the rolling proceeds, and automatic mechanism for turning the feed or adjusting screws down to effect the successive reductions by a predetermined number of passes of the metal between the rolls and then automatically running the feed-screws back to position for repeating the operation on the next series of bars, sheets, or packs, whereby the mill is caused to make a predetermined number of passes of the metal between the rolls and each with a predetermined amount or degree of reduction with comparative rapidity and before the metal loses its heat and then automatically return to place for repeating the operation, thus effecting a great saving of skilled and high-priced labor and at the same time producing a much greater aggregate reduction of the metal at each heat, and also entirely obviating all danger of straining the mill or breaking the rolls, as heretofore has frequently happened owing to the carelessness or misjudgment of the operatives in setting the rolls closer together for the next pass.

My invention further consists, in connection with the rolls adapted to pass the bars or sheets between them successively in opposite directions and feed screws or devices for setting the rolls closer together after each successive pass, of mechanism for automatically turning or adjusting the feed screws or devices after each successive pass and mechanism for automatically changing or regulating the extent to which the feed screws or devices are turned or moved after each pass or after any given number or series of passes, so that as the metal cools a less and less reduction may be effected at each pass or at each pass of each successive series of passes.

It further consists in providing the feed-table with movable gages or guides which are automatically operated to square or true up and center the bars or sheets on the feed-table after each pass preparatory to their being again passed between the rolls.

It further consists in the combination, with the rolls and feed-table or feed devices upon which the sheets rest, of a sheet trimming or shearing mechanism to which the sheets are delivered by the feed-table of the rolling-mill.

It further consists in the combination, with the rolls and feed-table, of a pack shearing and slitting mechanism.

It also consists in the novel construction of parts and devices and in the novel combinations of parts and devices herein shown and described, and specified in the claims.

The feed-screws are turned at intervals by connecting them with a power-driven pulley through a suitable clutch, and they are automatically operated after each pass, at the

beginning of each reversal of the rolls, preferably by means of a cam frictionally connected to the shaft of the driven roll and which, through suitable connecting mechanism, controls the operation of the clutch through which the feed-screws are connected with their driving-pulley, although any other suitable mechanism may be employed for thus automatically operating or turning the feed-screws at each reversal of the motion of the mill. The means or mechanism which I prefer to employ for automatically changing or regulating the extent to which the feed-screws are turned, after each pass or after each successive series or number of passes, consists in a set of gears of different diameters which successively engage a set of segment-gears of different diameters and which are interposed in the connecting mechanism or gearing connecting the feed-screws with their driving-shaft, although any other suitable means or mechanism may be employed in the combination as the equivalent of the set of gears and segments of different diameters. By this means I am enabled after each pass of the bars or sheets between the rolls not only automatically to set or adjust the rolls for the next pass, but also after any pass or any given number or series of passes—as, for example, five—to automatically change or regulate the extent to which the feed-screw shall be turned at each pass or at each pass of the next succeeding series of, say, five passes, and so on, thus accommodating the action of the mill to the changed conditions of the sheets or bars due to the lapse of time and loss of temperature as the rolling proceeds.

In the drawings I have illustrated my sheet-metal-rolling mill as being arranged and adapted to turn or adjust the feed-screws an equal extent for each of a series of five passes, and then an equal but less extent for each of a succeeding series of five passes, and then an equal but still less extent for each of a final series of five passes; but it will be understood that by simply changing the intermeshing gears and segments and employing a greater or less number of gears and segments the automatic changing or regulating of the extent to which the feed-screws are turned may be made to occur with greater or less frequency or after each and every pass, if desired, or as may be required for the particular nature of the work being done by the mill. By this means I am enabled to save or entirely dispense with the skilled and high-priced labor heretofore employed for turning or adjusting the feed-screws after each pass for feeding or passing the sheets centrally and squarely to the rolls and for returning the sheets to the rolls after each pass, and at the same time I am also enabled to make the successive passes much more expeditiously, and thus effect a much greater reduction at each heat. I also entirely obviate all danger of breaking the rolls by improper adjustment of the feed-screws, an occurrence which very frequently happens, owing to the carelessness or misjudgment of the screw-man.

In the drawings similar letters of reference indicate like parts throughout all the figures.

In said drawings, Figure 1 is a plan view of a sheet-metal-rolling mill embodying my invention. Fig. 2 is a front elevation looking from the line 2 2 of Fig. 1 in the direction of the arrow. Fig. 3 is a side elevation. Fig. 4 is an enlarged detail plan view illustrating the mechanism which I prefer to employ for changing or regulating the extent to which the feed-screws are turned at or in each successive series of passes. Fig. 5 is an enlarged partial vertical section taken on the line 5 5 of Fig. 4. Fig. 6 is a detail plan view of the mechanism for operating the movable gages of the roller feed-table, and Fig. 7 a detail elevation of the same.

In the drawings, A represents the frame of the machine.

B B′ are the rolls, the lower one B being the driven roll. C is the feed-table upon which the bars or sheets rest and by which they are fed or passed back and forth between the rolls successively in opposite directions.

D D are the feed-screws turning in the housings D′ of the frame, by which the rolls are set closer and closer together after each successive pass. The lower ends of these feed-screws press against the bearings B^2 of the shaft B^{33} of the upper roll.

The feed-screws D D are turned at intervals by power communicated to them from the feed-screw-driving pulley F^3 through suitable connecting mechanism or gearing, including a clutch $F' F^2$, by which the shaft F is connected at intervals to the driving-pulley F^3.

The means or mechanism employed to operate the clutch $F' F^2$ after each successive pass, at the reversal of the motion of the mill, consists, preferably, of an oscillating cam G, secured frictionally to the shaft B^3 of the lower roll B, and which is adapted to oscillate slightly to one side or the other until it engages one or the other of the stops G′ G′, attached to the frame. The frictional connection between the cam G and shaft B^3 permits the roll to continue its rotation after the cam engages the stop, while at the same time causing the clutch $F' F^2$ to be operated and the turning of the feed-screws to set the rolls for the next pass to be made at the beginning of the reversal of the motion of the mill and before the feed-table C enters the bars or sheets between the rolls.

Any suitable connecting mechanism may be employed for communicating motion from the cam G to the movable member of the clutch $F' F^2$; but I prefer to employ for this purpose a reciprocating slide g, having a pin or roller g', engaging the cam, and which is provided at its upper end with a pawl or dog g^2, which is adapted to engage a collar or pro-

jection g^3 on the clutch-operating rod g^4. A spring g^5 holds the pawl normally in position to engage said collar. A stationary cam g^6, engaging the free end of the pawl or dog g^2, causes it to disengage said collar on the clutch-rod, after having first operated the clutch-rod, so that the spring g^7 on the clutch-rod may return it to position to again disengage the clutch after the shaft F has made one revolution. The shaft F is provided with a gear F^4, engaging a gear F^5 on a shaft F^6, said gears being preferably so related to each other that the shaft F^6 makes, for example, one revolution to every five revolutions of the shaft F.

The means or mechanism which I prefer to employ for automatically changing the extent to which the feed-screws are turned at each pass or after any given number or series of passes—say, for example, five—consists in inserting in the connecting mechanism or gearing by which motion is communicated from the shaft F^6 to the feed-screw shaft a set of gears of different diameters H H′ H^2, preferably three in number, and a corresponding set of segment-gears h h' h^2 of different arc lengths and arranged one after another, or each at the point where its predecessor terminates, as will be readily understood from Figs. 4, 5, and 2.

If it is desired to change or regulate the extent to which the feed-screws are turned more or less frequently than illustrated in the drawings, all that is required is simply to substitute for the gears F^4 and F^5 other similar gears having a different relation to each other and for the set of gears and segments H h H′ h' H^2 h^2 other sets or a greater or less number of similar gears and segments, and thus any desired frequency of change or regulation of the extent to which the feed-screws are turned may be produced, or after each and every pass, if desired.

The feed-screws D D are geared together, so as both to rotate in the same direction by gears D^2 D^2 through an intermediate gear D^3. The gears D^2, instead of being fixed directly to the shafts of the feed-screws D D, are connected thereto through the medium of worm-gears D^4 D^4, which fit on the squared ends D^5 D^5 of the shafts of the screws D D, and which worm-gears engage worms D^6 D^6, journaled in brackets on the gears D^2, so that by turning the worms D^6 by hand the screws D may each be independently turned or adjusted in respect to each other as may be required from time to time to compensate for wear or to bring the rolls B B′ truly parallel to each other. The set of segment-gears h h' h^2, which successively mesh with the set of gears H H′ H^2, are secured to or formed integral with the gear D^2 on one of the feed-screws. The gear D^2 on the other feed-screw is provided with a bevel-gear D^7, which meshes with a bevel-gear K on the shaft K′, which is connected by a clutch K^2 K^3 with the driving-pulley K^4, by which the feed-screws D are turned back or unscrewed after the rolling of the bars or packs on the feed-table C is finally finished or completed for the heat. This clutch K^2 K^3 is automatically operated after the rolling is thus completed by a cam K^5 on one of the gears D^2 engaging a lever K^6, from which, through suitable connections K^7 K^8 K^9, motion is communicated to the movable member of said clutch.

The feed-table C may be of any suitable kind or construction adapted to feed or pass the sheets in opposite directions after each successive pass. It is preferably what is commonly known as a "roller" feed-table and comprises a series of rolls c, having beveled gears c', engaging bevel-gears c^2 on the shafts c^3 c^3. Motion is communicated to the shafts c^3 in opposite directions as the motion of the mill is reversed, preferably by providing the shaft of the driven roll B with the bevel-gear b, engaging a bevel-gear b' on the shaft b^2, which has a second gear b^3, engaging a gear b^4 on the shaft b^5, from which motion is communicated to the shafts c^3 by the pulleys b^6 b^7 and connecting-belts.

The feed-table C is furnished with movable gages or guides C′ C′ at its opposite edges, which are automatically operated to approach each other after each pass of the bars or sheets between the rolls, and thus by grasping the bars or sheets at their side edges to automatically true or square up and center all the bars or sheets on the feed-table preparatory to their being again passed between the rolls, so that they will all enter the rolls smoothly and centrally with the rolls. After the bars and sheets are thus automatically adjusted properly in position on the roller feed-table the gages or guides again open or separate, and thus permit the bars or sheets to be fed forward by the roller feed-table into the rolls without friction-contact with the gages. The gages or guides C′ C′ may thus be automatically operated after each pass by any suitable means or mechanism, but preferably by a cam or arm C^2, frictionally secured to the shaft B^3 of the driven roll B, similarly to the friction-cam G, and which is adapted to vibrate from one of the stops C^4 C^4 to the other at each reversal of the rolls and which is connected to the slides C^5 C^5, carrying the opening and closing gages C′ C′, preferably by means of a link C^6, pivoted to the friction cam or arm C^2 and to a lever or arm C^7, which is connected by a link C^8 with a rack C^9, that meshes with a gear C^{10} on a rack-shaft C^{11}, that is provided with a pair of lever-arms C^{12} C^{12}, connected by links C^{13} C^{14} and intermediate levers C^{15} with the gage-carrying slides C^5 C^5, so that at each movement of the friction cam or arm C^2 the two gages C′ C′ are first made to momentarily close or approach each other to center and square the bars or sheets on the feed-table, and then at once to open or separate to permit the bars or sheets to be fed forward into the bite of the rolls

without again touching the gages, which might otherwise tend to disarrange the bars or sheets on the table before entering the rolls.

M represents the mechanism for squaring, trimming, or shearing the end edges of the sheets after the rolling has been completed. It may be of any suitable construction known to those skilled in the art and needs no special or detailed description. The sheets are delivered from the roller feed-table C of the rolling-mill onto a feed-table M′, from which the sheets to be trimmed are fed or passed between the rotary cutters M^2 of the sheet-trimming mechanism. Feed-rollers M^3 serve to feed the sheets onto this feed-table M′. The sheet-trimming mechanism which I prefer to employ and which I have indicated in the drawings is that shown and described in Letters Patent No. 560,065, granted May 12, 1896, to John G. Hodgson.

N represents a mechanism for trimming and subdividing or slitting packs of metal sheets as they are delivered from the feed-table of the rolling-mill. This trimming and slitting mechanism may be of any suitable kind known to those skilled in the art and therefore needs no detailed description. The mechanism for this purpose which I prefer to employ and which I have therefore illustrated in a general way in the drawings is that shown and described in Letters Patent No. 560,064, granted May 12, 1896, to John G. Hodgson.

The packs of sheets after being rolled are delivered by the roller feed-table C of the rolling-mill directly onto the feed-table N′ and between the feed-rolls N^2 of the trimming and slitting or subdividing mechanism, and thence between the rotary trimming-cutters N^3, thence between the feed-rollers N^4 to the roller feed-table N^5 of the slitting or subdividing mechanism, and thence passed transversely between the feed-rollers N^6 to the slitting or subdividing rotary cutters N^7, and thence out of the machine between the delivery-rolls N^8.

In operation the motion of the driven roll B may be reversed by any suitable mechanism after each pass; but this is preferably done by simply reversing the engine by which the mill is driven.

To enable the mill to be run any desired number of passes without feeding, setting, or adjusting the rolls closer together, as is sometimes desired, I provide the mill with means for fixing the cam G stationary. This means may preferably consist of a pin g^8, inserted through the cam and entering a hole g^9 in the frame.

To provide the mill with means for readily setting or adjusting the feed-screws to any required thickness of metal or to any required distance of the rolls B B′ apart when the feed-screw-driving gears are turned completely around or down, I provide two gage plates or disks to fit between the end of the feed-screw and the bearing of the upper roll, one of which is less in thickness than the other by the thickness of metal to which the bars, sheets, or packs are designed to be finished, so that in setting or adjusting the mill the thicker gage-plate P may be inserted and the rolls then set down directly together, the screws being at this time turned down ready for re-turning, after which the thicker gage-plate is removed and the thinner one P′ inserted in its place. This makes an easy and expeditious means for setting or adjusting the mill to any required thickness designed to be rolled. These gage-plates, in connection with the feed-screws, also serve as a ready means for readjusting or resetting the mill to compensate for wear.

The same mill may be employed for rolling bars or plates, as a roughing-mill, or for rolling packs of thin sheets, and for this reason I combine with the same mill both a trimming and shearing mechanism for trimming or squaring the ends of the single sheets rolled from the bars, and also a pack trimming and subdividing mechanism for the finished packs. After the rolling has been completed to deliver the bars, plates, sheets, or packs to either of the cutting mechanisms the mill is simply continuously driven in the same direction in which it was rotated for the last pass until all the several packs, plates, or sheets on the roller feed-table C are delivered onto the feed-table of the cutting mechanism.

I claim—

1. An automatic rolling-mill for reducing bars to thin sheets, or packs of sheets to thinner gages, consisting of rolls to reduce the metal to the desired thickness, feed-tables to feed the metal to the rolls and to receive it from the rolls, gages to center the metal on the feed-tables, feed-screws for adjusting the rolls, and automatic means for turning the feed-screws whereby the mill is caused to make a predetermined number of reductions of the metal and then return to place for commencing another similar series of reductions without the aid of skilled workmen, substantially as specified.

2. In an automatic rolling-mill, the combination with rolls to reduce the metal, of a feed-table to feed the metal to the rolls and receive it from the rolls, parallel opening and closing guides one on each side of the feed-table to center the metal sheets or bars on the table, feed-screws for setting the rolls closer together after each successive pass, automatic mechanism for turning the feed-screws after each successive pass, and means for automatically moving the guides after each pass, substantially as specified.

3. In an automatic rolling-mill, the combination with rolls to reduce the metal of a feed-table to feed the metal to the rolls and receive it from the rolls, parallel opening and closing guides one on each side of the feed-table to center the metal sheets or bars on the table, feed-screws for setting the rolls closer together after each successive pass, automatic mechanism for turning the feed-screws after each